THE AMERICAN X-RAY JOURNAL

Devoted to Practical X-Ray Work and Allied Arts and Sciences.

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The electrograph herewith shows the condition of a patient eighteen months after the disease began. A full conception of the depth can not be had from the picture because at the time the picture was taken the ulcerous excavation was packed with gauze. The flesh had sloughed from the side and back and to within three inches of the spine. The axilla was undermined almost to the glenoid cavity. The breast that had not fallen off was hard and insensative. It was crusty and had the appearance of dry gangrene. Ulcerous nodules abound over

the chest and back while the base of the vast area that had sloughed away was pale and smooth. The patient was carried to Dr. Robarts' office almost moribund. She was too weak to talk. Her pulse was too frequent and weak and irregular to count. Of course the case had been abandoned as inoperable. An optomistic uncle insisted that she be treated so long as she lived. No surgery had ever been done. Great masses of dead flesh were adherent to the edges of the ulcer. The discharge was profuse and the odor most foul. The coil and tube was used exposing the affected parts, ten minutes each, thirty minutes in all, the first sitting. The tube was a German make adjusted to give visual radiation of the carpus two feet, the patient one foot from the tube. The patient immediately improved physically. With a few exceptions the treatments were daily till the twentieth exposure when she was suddenly attacked with hypostatic pneumonia and died on the twenty-ninth day after the first treatment. The wound had wholly ceased to slough, odor had long since ceased, pain was gone, the wound was healing at many places about the edges: at one place it had filled in nearly one inch. Her sleep, strength, appetite and appearance had greatly improved.

The picture was taken two weeks before death and is reproduced to show how a body can compensate and live with so extensive decaying tissue; and also to show that notwithstanding the nearness to death the x-rays gave demonstrated hope when all other procedures known to man had failed.

THE AMERICAN
X-RAY JOURNAL.

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VOL. 10. *ST. LOUIS, MAY, 1902.* *No. 2.*

The Practical X-Ray Diagnosis.

Prepared by J. Rudis-Jicinsky, A. M., M. D., M. E., Cedar Rapids, Ia. Revised by M. U. Dr. Joseph Hoffman, Vienna, Austria.

A series of A. B. C. teaching for workers in x-ray diagnosis and therapeutics, to be concluded in 20 articles. Fully illustrated.

Description of Parts. Source of Electric Current.

LESSON II.

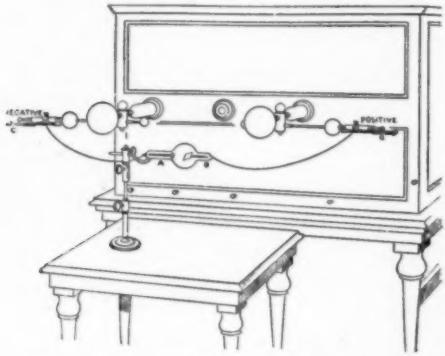
We know that an electric current is a source of energy—that is to say, it is capable of doing work. This is clear from its power of evolving heat, one form of energy. But the electrical energy may be transformed directly into mechanical work, and from there, according to the principle of conservation of energy, when we keep up a constant supply of the same, into the unknown ray so convenient in our diagnosis. The simplest way of considering the different sources of electricity will be to divide the first into two main divisions, according to the kind of energy which is employed to maintain the current. These two kinds of energy are: 1. Mechanical Work; 2. Energy of Chemical Action.

Electrical Measurement.

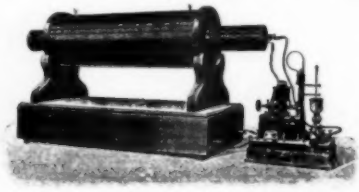
The successful operator in radiology requires to know not only whether a current will be produced under certain circumstances, so that he may be able to determine the conditions most favorable to its production, but he has to remember also, the electric quantity conveyed in one second by his current of unit strength. These units are based on the centimetre as measure of length, the gramme as a measure of mass, and the second as a measure of time. The practical unit of electric current is defined as one-tenth of the centimetre, gramme second unit of the current, and is called an Ampere after the great French electrician of that name. The unit of electromotive force is called a Volt, after Volta, and is taken to be a hundred million C. G. S. units. The unit of resistance, which is called the Ohm, is then defined as the resistance of a conductor through which an electro-motive force of one Volt will produce a current of one Ampere. The unit of power employed is defined electrically as the power developed in a circuit traversed by a current of one Ampere with a potential difference at its terminals of one Volt. This unit is called Watt.

As has been previously stated, various methods of generating the electric current for the production of the x-rays may be employed, namely: Primary Batteries, Plunge Batteries, or Accumulator Batteries, Static Machines, or the charging may be done by means of an Electric light Installation, Thermo-pils and Constant, Direct or Alternating Current, each working equally satisfactorily, but requiring more or less different accessory apparatus to add to their general efficiency. The least expensive form in end for the general practitioner,

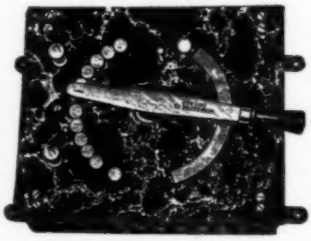
I think, is to employ a good Static Machine, which may be used for both purposes, the Electro-Therapeutics and Radiology, or if we use the induction coil, the Primary Batteries, and any good set of cells giving the voltage required to operate the coil, will answer. Either, if properly constructed and in the hands of a competent manipulator, will do the x-ray work.



The average voltage required by 8 to 10-inch coil is about 10.6 volts, represented by twelve cells of Edison Laland Battery Type S. With these cells, the outfit consists simply of the vacuum tube, coil, fluoroscope or screen, and batteries, the electro-motive force of the cells making it safe to use the vibrator of the coil without injury to the same,



while the single condenser in the base of the coil has sufficient micro-farad capacity to give a good fluorescence. Better and more steady discharge is obtained by the employment of an additional adjustable multiple condenser of at least 2.5 micro-farads. For a coil giving 12-inch spark we have to have twelve Edison Laland cells. Where there is no other source of electricity at disposal, recourse to such a battery can be taken. It has, however, the inconvenience of requiring frequent replenishing of the cells.

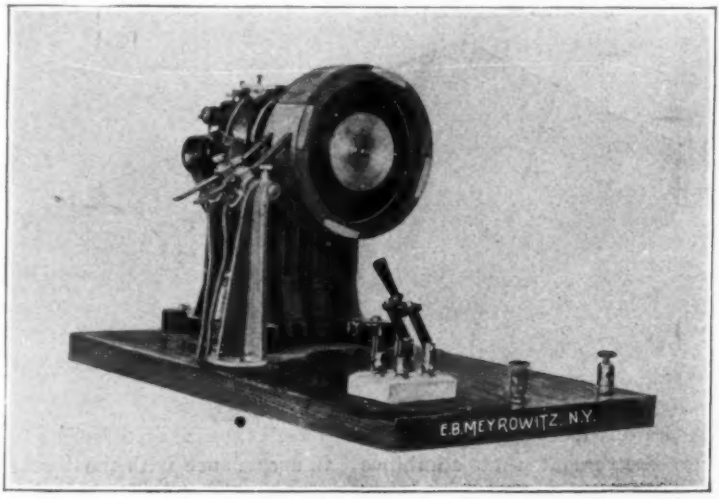


If no lighting circuit is to hand, accumulators or storage cells are recommended as being a useful and sure source of current. For the same results as above we use six storage cells, giving twelve volts. The difference between the two types of batteries is that the storage cells can be kept operative by being recharged at stated periods at any electric light station, while in the primary cells, the entire elements are consumed and have to be replaced. In making these statements, high speed interruptions are contemplated, and we employ a make and break wheel operated by a motor, which takes the place of the vibrator on the coil. Two additional storage cells are required to operate the motor.

If a lighting circuit is at disposal, which supplies continuous current, it will be very convenient to utilize this source of electricity for working the induction coil, or with the help of motor and a good rheostat a Static machine may be manipulated with good results. When making use of the constant incandescent current, it is only necessary to employ a shunt board to reduce the current to the required voltage, This will operate the coil in the same manner as the batteries, but the source of current being inexhaustible, it is, of course, preferable. At the same time a pro-

portionately better result is again obtained by the make and break wheel or interrupter, the motor of which can also be operated by the current. In this case the necessary resistances for regulating the strength of current must be interposed in the circuit. The current of the apparatus should be directly branched off from the main circuit and be provided with needful safety-fuses. The resistances are arranged so that a fixed resistance remains constantly interposed, and second resistance is adjustable for regulating the tension at pleasure. Now for instance, if we use the one hundred ten V. current from street circuit, the control of the voltage may be done by the interposed ten or more thirty-two candle power incandescent lamps, placed in series, reinforced by a sliding Rheostat. This gives ample power, and prevents a side variation.

If our lighting circuit supplies an alternating current, the use of a new coil consisting of two separate secondaries with their primaries connected in series, is recommended. Each such secondary must have a high and low potential terminal, due to position and method of winding. The secondary is wound in a disk, and the discharge from the two terminals is vastly different from the discharge of the Rumkorff coil or Tesla's transformer. Such apparatus is not only portable, but can be attached to any lamp socket, either in the physician's office, the ward of a hospital, or carried in a buggy, and attached to the alternating current socket in the patients' room, but if necessary, a storage battery may be employed. The alternating current can also be used in connection with a Static machine and a motor, but in such cases the direct current gives more satisfaction.



Static Machine.

LESSON III.

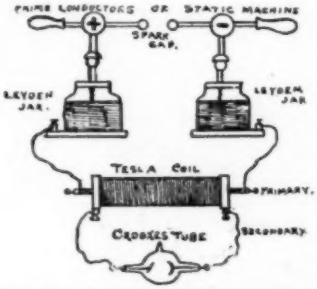
Although the discovery of static electricity was made by Guericke in 1671, and the treatment with static electricity recorded in 1750 and brought to America in 1752 by Franklin, more than two centuries ago, yet, it appears to have shared the common fate of most discoveries made before their time, and to have in main been forgotten. It has always been considered natural that electricity has some influence in some diseased condition, but a complete cure of some

cases by static electricity has generally been looked upon as an absurdity. Yet, the adage, *natura non agit saltatim*, has its application even here. For it is the scientist rather than Nature, who has drawn hard and fast lines everywhere—who marks out abrupt boundaries where she herself shades off with gradations. The static electricity has weathered many storms of adverse criticism, but with the remarkable discovery of Prof. Wm. Conrad Roentgen, it was found, that unlike other apparatus for x-ray generation which possess but single utility, the main representative of static electricity, the influence machine, is a commodity of the utmost therapeutic

value. A Static Machine may be utilized as an instrument that combines treatment with diagnosis, capable of accomplishing good work in the x-ray field, and exercising a power to produce a thoroughly efficient form of medication in Electrology and Radiology both. The Static Machine is a very simple, safe and most convenient method of producing x-rays, especially in the office of the busy practitioner, and being independent of an electric circuit from the street, and generating its own electric source, it can be operated very easily in any locality, and is always ready for instant use.

In the Static Machines, powerful charges are produced by the revolution of glass disks arranged with rubbers, collectors and inducing strips; they may be strictly frictional or "influence" machines. The charges produced reside only on the surfaces of the bodies charged, and two mutual and equal phases of excitement are developed, the positive and negative charges with affinity for each other, neutralizing both. If the charge is great enough, the positive and negative surfaces need not be in actual contact, and we get a good spark for our x-ray work. It is necessary to find out first which is the positive and the negative prime conductor on our machine. The conductors are then connected with small condensers, known as "Leyden Jars," the size of these jars to be selected in accordance with the degree of vacuum of our Crooks tube. The connecting wires resting on some wooden support, stand, have to be covered with rubber tubing and go to the cathode and anode of our Crooks tube, having for the successful excitation of the same as a key, the spark-gap between the discharging rods of the machine, when starting. The length of spark depends altogether upon the size of our "Leyden Jars," the vacuum in the Crooks tube or the interrupter used on the discharging rods. Experience will teach us to regulate the length of a spark necessary for good effects. The jars may be omitted on account of a possible explosion, but

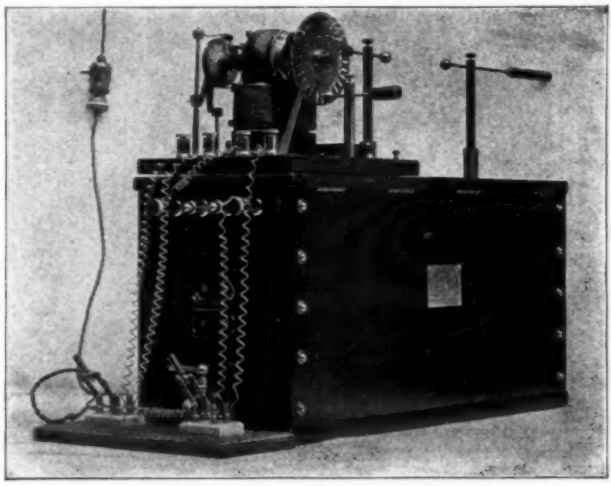
their action as condensers, if carefully manipulated, increase our volume of electricity, and give us more steady radiance. In my laboratory I have used, with comparatively good results, to bring my ten-plate Static Machine in proper motion, the direct current with one-fourth h. p. motor and rheostat with eight buttons.



The glass plates must always be turned to the left, looking at the machine from the front, and the revolutions may vary from 300 to 350 and more in x-ray work. To charge the machine we have to place the discharge rods about half an inch apart. The small arm on the front right-hand end of the case, if there is separate charger, should be turned down and the small chain attached to this arm should be hooked over the left-hand pole-pieee, so as to connect the small plates with the large plates; then start the small plates or Wimhurst machine, by turning the small handle to the right, making several revolutions, until the maximum spark is obtained; then stop the Wimhurst and immediately start the large plates by turning the driving wheel with or without the motor, to the left. The chain is then unhooked and the arm turned up. This explains one method of charging, but every make of machine has its own special device to do the same thing. Separate the discharge rods about an inch, and when machine is in action it will be seen that the current given off the positive pole is whiter in appearance, and has longer, straight handle to the spark produced. The discharge rods should be separated the full distance between the pole-pieces if necessary. The smallest jars will give the finest current; the medium jars have to touch the bottom of the same, and the connections must be properly made. Ordinarily, the machine should be let alone and the case never opened, except when necessary to adjust a plate or comb,

or to oil the shaft of the Wimshurst. When difficulty may be experienced in charging the machine, we may use, in humid weather, Calcium Chloride—about ten pounds, distributed in dishes in the four corners of the case—but never allow the Calcium to become fluid, and be careful not to use Chloride of Lime. The case must always be tightly sealed. If a motor is to be used for power, move the pulley nearer to the

end of the shaft, so that the belt will clear the case, and run the belt direct to the motor, which is usually placed on the floor or a shelf made for the purpose. A good Static machine of modern construction, if properly groomed and kept in order, will excite a tube equal to the requirements of general practitioners, and its usefulness, therapeutically, adds additional value. We have found that 10-16 plates will generate a sufficiency for all therapeutic and

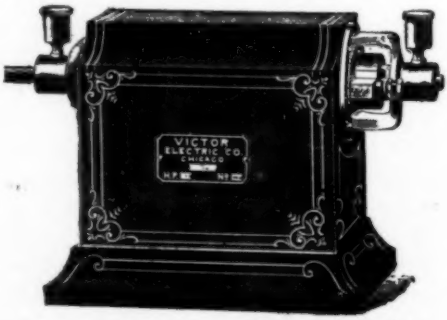


x-ray purposes.

In the laboratory of the expert x-ray worker, we will find the coil, just as well as the Static machine, but at the present time, there are but three forms of apparatus from which to choose, viz: the Rumkorff or simple form of induction coil, the Tesla or high induction coil, and portable; and the Static machine.

Very early in the history of the x-ray it was found that we have to deal only with the shadows, with all the limitations which the term implies. By repeating experiments, research, facts, experiences, better apparatus and better technique, we are now able to photograph not only the shadow of the bones, but the substance of the same, and do work that is much more successful.

There has been much written about the fallacies of the x-ray, tending to push aside this new method of diagnosis. But how about microscope, ophthalmoscope, or any other delicate instrument? You have to look until you see something; and in fact, to the unpracticed eye, the microscope or opthalmoscope is



much more liable to lead one astray than the very simple application of the x-ray. To practice medicine, we have to study;

to manage an individual case of typhoid, we have to read; to operate in a difficult case, we have to look up our authorities, etc., and to manage the new means of diagnosis, the x-ray, we have to study just as well.

It is very simple, indeed, to get hold of the handle or switch and produce the x-ray with the help of the coil or the Static machine, but it is really very difficult to manage the same and to know what to do in some cases, when the fundamental laws and principles of Electrology and Radiology are not understood. And let us state right here, that such and similar nonchalance was the main cause of misrepresentations and many mistakes in the beginning of x-ray phenomena, attributed falsely to the x-ray, instead of the operator himself.

A BOOK.

At last a book has been made for the benefit of x-ray workers. The title of the book is "A Pictorial System of Instruction." The volume is classed into six grand divisions: X-Ray Diagnosis, X-Ray Therapy. These two make up four-fifths of the entire book of over 1,000 pages. The remainder is devoted to Photo-Therapy, Hot-Air Therapy, Vibration Therapy and High Frequency Electric Currents. The book abounds with illustrations with explanatory foot-notes and referred to in the text for the purpose of quickening understanding and amplifying intellectual greed. There are no apparatus advertised in this precious book. This is left to the makers of machines, from whom doctors can get catalogues for the simple asking. This work is wholly new and has no parallel, even in part, in any book previously written. It is a concise, plain series of instructions to the worker of an x-ray machine. The doctor may read and at once imitate the practice of this great master, so simple are its teachings. The wide therapeutical aspect of radiation has sealed the importance of the x-rays in the mind of every true thinker of pathology. This Pictorial System of Instruction lifts the cloud of doubt, and to the practitioner everywhere draws aside the veil of hindrance to easy uses of the x-rays in diagnosis and to practice. This is Dr. Monell's best work. We will review the book in a subsequent issue of the AMERICAN X-RAY JOURNAL.

H. R.

Readers of the AMERICAN X-RAY JOURNAL are acquainted with correct methods of x-ray therapy.

The AMERICAN X-RAY JOURNAL is an *index medicus* of all that goes on in the x-ray world.

If you want the truth about the uses of the x-ray, purged of verbosity and speculation, read regularly the AMERICAN X-RAY JOURNAL. Where else can you get it?

We are pleased to note that Dr. H. H. Fabrique, Chief Surgeon of St. Francis Hospital, Wichita, Kansas, called upon Dr. Robarts during past week for instruction in the therapy of the x-rays. Dr. J. M. Haney of Centralia, Ill. and Dr. Albert H. Dollear of Jacksonville, Ill. were also here in the same capacity. It is a good sign when physicians seek the best means for information.

Priority in X-Ray Therapeutics.

A Summary of the Work Done in 1896.

(Report of the Research Committee of the Chicago Electro-Medical Society). Adopted March 25, 1902.

The first published suggestion for the therapeutic use of the x-ray appears to have been made by Dr. T. Glover Lyon in a letter to the London Lancet, February 1, 1896, page 326. This was followed by a second letter dated February 17. 1896 giving an account of his exposure of the bacilli of tuberculosis and diphtheria, in cultures, to the x-rays for twelve hours, with results entirely negative.

In the Munchener Medicinische Wochenschrift for February 4, 1896, pages 101, 102, Dr. Franz Mink gave an account of two exposures of bacteria cultures to the x-rays, for about half an hour each, with negative results. In the March number of the same journal, page 202, Dr. Mink reported a second exposure of a culture of the typhus bacilli in agar, for fifteen hours, with negative results.

On February 17, 1896, Professors Schuster and Delepine of Owens College (British Medical Journal, February 29, 1896) exposed to the X-Rays three sets of culture tubes containing cholera vibrio, bacillus coli communis, and bacillus typhosus, for 15, 30 and 60 minutes respectively. Two days later a similar set was exposed to the rays for two hours. The results were negative in both cases.

On April 5, 1896, Drs. H. Preston Pratt and Hugo Wightman of Chicago exposed to the x-rays for one, two and three hours respectively, three sets of culture tubes of the following bacilli: cholera, diptheria, influenza, glanders, pneumonia, typhoid, tuberculosis and anthrax. Several of the cultures were killed by one hour's exposure; and all by three hour's exposure.—(*Chicago Times-Herald*, April 13, 17, 18; *Chicago Tribune*, April 14, 1896.) April 13, 1896, Dr. Pratt treated two patients who had cancer of the stomach, who were immediately benefited by the exposures of one hour each.—(*Chicago Tribune*, April 14.) Guinea pigs were inoculated, April 18, with tubercular bacilli.—(*Times-Herald*, April 19,) and exposed to the x-rays for one hour daily. Those thus treated lived, though with x-ray burns; the controls all died of tuberculosis.

Dr. Pratt by request of the *New York Journal*, began the treatment of a case of pulmonary and laryngial tuberculosis by the x-rays, April 19, 1896. After one week, during which improvement was very marked, the patient left the city, and later died.—*New York Journal*, April 19, *et seq.*)

On April 23, 1896, Drs. Lortet and Genoud inoculated eight Guinea pigs with tubercular bacilli, and exposed three of them to the x-rays one hour daily. These three remained well; the rest developed suppurating abcesses.—(*Medical Week*, Paris, Vol. IV, 1896, pp. 326-27.)

Professors Schroder and Hickman of Missouri, April 27, snceeded in destroying the bacilli of diphtheria by the x-rays.)—*Chicago Tribune*, April 28, 1896, page 4.)

Two pronounced cases of pulmonary tuberculosis successfully treated by Dr. H. P. Pratt were reported by Dr. Finley Ellingwood in the *Chicago Medical Times*, Vol. XXIX, No. 7, July, 1896, and Sept. 1896. Treatment of the first was begun April 17 and continued for

six weeks, with marked improvement. Treatment of the second began May 20, and in September, 1896, he was to all appearances completely cured. (See also *The Clinic*, July 15, 1897.)

Dr. Stone of Fort Leavenworth, in a letter to the Association of American Physicians, April 30, 1896, stated that the x-rays in his experiments appeared to have no destructive effect upon bacteria.

Dr. F. Berton (*Medical Week*, Vol. IV, 1896, p. 351) exposed broth cultures of bacillus diphtheria to the x-rays for sixteen, thirty-two and sixty-four hours, without effect.

Dr. Despeignes (mentioned in *Medical Record*, August 29, 1896, page 307) used the x-rays for a case of carcinoma of the stomach. The patient improved under the treatment, but died later.

During the latter half of 1896, Drs. Pratt and Stirling (*Chicago Medical Times*, December, 1896, page 456) treated a number of disorders successfully with the x-rays; among which were lupus (in June), sciatica (in July), emotional melancholia (in September), dorsal pain, articular rheumatism, and tuberculosis of the kidney.

Dr. J. Tarkhanoff, in Gazetta Bolkina, 1896, No. 33, (*Presse Medicale*, February 24, 1897) reports the recovery of frogs poisoned by strychnine, when exposed to the x-rays. Those not exposed died.

Drs. Rendu and du Castel (*Progres Medical*, January 30, 1897, page 71; and *La Semaine Medicale*, 1897, page 20) gave a pneumonia patient relief in three applications of the x-rays.

Dr. Freund (*La Semaine Medicale*, 1897, page 24) reported the cure of a large, pigmented, hairy nevus by x-rays.

Dr. E. Aussat (*Jonrnal de clinique et de therapeutique infantile*, February 11, 1897; and *Lancet*, March 6, 1897, page 630) found no effect of the x-rays upon tubercular bacilli in cultures; but treated a child of seven years, by the rays for pulmonary and abdominal tuberculosis, with marked improvement.

Dr. Voigt, Hamburg, in November, 1896, treated a case of pharyngial carcinoma.—(Mentioned by Dr. Gocht in *Gebiete der Roentgenstrahlen*, Vol. 1, page 14.

Dr. Schiff at Versammlung Deutscher Naturforscher und Artze in Braunchweig, September 22, 1897, gave a report of his work in the treatment of lupus, extending over about one year.—(*Fortschritte suf dem Gebiete der Roentgenstrahlen*, Vol. 1, 1897-8, page 89.)

THE ROENTGEN SOCIETY OF AMERICA will meet sometime in December in annual session, unless changed by the managing board. Chicago will probably be the place of meeting.

THE ROENTGEN SOCIETY OF LONDON have changed the rules that similar agents to the x-rays may be discussed at their meetings. They have two classes or character of meetings. One class admits the laity. These meetings are more for exhibition purposes and probably convivial. The other class admits members only or professional persons. In these meetings diagnosis and treatment are discussed. Their meetings are monthly. Election of members and officers occurs once a year if the new ruling prevails.

The two great meetings of the ROENTGEN SOCIETY OF AMERICA, the one in December, 1900, in the Grand Central Palace, New York City, and the other in September, 1901, in the University of Buffalo, Buffalo, N. Y., will go down in the history of medicine as the most valuable meetings for the diffusion of x-ray information ever held. As time goes on and the importance of this subject grows, every member of the Society that attended these meetings will be honored for having embraced that opportunity.

Dr. J. F. Rinehart of Oakland, California, has recently reported satisfactory treatment of Epithelial Skin-Cancers and Sycosis Non-Parasitica with the x-ray.

The New Machine for 1902.

By JOHN TOWNSEND PITKIN, M. D.

Since the discovery of the x-rays by Professor Roentgen, each successive year has been productive of new and better apparatus for their generation.

Static machines having but eight revolving wheels have been replaced by others having ten, twelve, sixteen, eighteen or twenty-four revolving discs.

With each increase in the number of plates, other improvements being commensurate, a given tube and speed and absence of spark gaps has placed proportionately more x-ray light at our disposal.

Instead of an eighth of a horse power electro-motor as the source of propulsion of the apparatus, we now require one-half of a horse power for its actuation. This means that we have nearly one-half of a horse power of x-radiance.

Other evidences of the increase in the power of the modern apparatus are the thickness (not the length) of the spark, brightness of the flash, the heavy report or detonation and greater therapeutic action.

Owing to a better selection of insulators and conductors and the relative positions which they bear to each other, the Static machine recently installed for the year 1902, with twenty-four (24) revolving cycles, occupies no more floor space than was required for any of its less efficient predecessors.

As air space is a fairly good insulator for high tension eiectrical currents, small machines have been cheaply built by inclosing them in large cases, placing the conductors entering into the construction of the case beyond sparking distance.

By employing heavy plate glass for strength and insulation with only enough wood work to hold it together and afford support for the axle, all of the space inside of the machine can be utilized for the generation of electricity.

The cycles of the new machine are twenty-nine inches in diameter. We have found larger plates less desirable because their "moment of inertia" is greater—harder to maintain in balance; hence, their speed is often limited by a vibratory or rocking motion. As any warp in the plates throws them further out of alignment, it is harder to keep them properly adjusted and to prevent rubbing. At an average speed their voltage is excessive.

The stationary plates consist of oblong pieces of glass, a superior and an inferior set. Each field plate is double, with a tin-foil inductor inclosed between them. The pieces of tin-foil are saddle shaped, with one serrated margin. Each inductor presents forty-two square inches of surface for electrification.

The advantage of the double over the single fields are manifold; they have greater exciting power and tenacity or retentivity of the same, inducing more action in the revolving disks, and rarely loose their charge or spark into the neutralizing system.

Glass is a better inducing medium than the air.

The field plates project beyond the revolving discs at either end of the machine eight inches.

The axle is incased throughout, except in the bearings, in a heavy, hard rubber sleeve; it is supported at either end by an upright (not horizontal) piece of wood, which extends from the top to the bottom of the case.

Over the sleeve of the axle solid hard-rubber discs are placed; they separate the revolving plates from each other and from the field plates, and hold the former firmly in situ.

Primary excitation is effected by the play of brushes against the outer revolving discs, after which the brushes are replaced by collecting combs.

All portions of the comb holders not bearing combs, and the neutralizing rod are incased in hard-rubber tubing.

Immersion of the Leyden jars in oil, an extra anterior and posterior plate, which are electrically inactive, and the passage of the arms of the prime conductors through the plate glass front, add greatly to the completeness of the insulation.

There are compartments in the base of the machine, one for absorbing chemicals, the second for an electrical heater, and the third for Crookes' tubes, etc., etc.

The top, ends, and back of the case are removable, affording free access to all portions of the machine proper.

The collecting combs of the external circuit are placed opposite to the tinfoil inductors, not their serrated margin.

At a speed of one hundred and fifty revolutions per minute, a large Crookes' tube of medium vacuum placed in simple series receives nearly all of the current generated by the machine, (the neutralizing circuit receives but little of the current) causing it to light up immediately, the target becomes red hot, but the excitation can be continued half an hour without injury to the delicate structures. Through the fluoroscope the human bones can be seen in the neighboring apartments of the building.

BUFFALO, N. Y.

Dr. G. E. Pfahler and Dr. C. K. Mills have reported in the *Philadelphia Medical Journal*, for February, a very interesting and useful article upon the uses of the x-rays in determining and locating tumors of the brain. The article is embellished with excellent radiographs.

In all subsequent issues of the AMERICAN X-RAY JOURNAL much attention will be given to the therapy of the x-rays. We predicted in the early history of the rays that raying would be a practice. Its value is now assured.

X-Ray Burns.

The fullest account of x-ray burns that has so far been published was printed in the AMERICAN X-RAY JOURNAL, August, 1897, Vol. I, No. 3. Dr. N. S. Scott, of Cleveland, Ohio, tabulated 69 cases and wrote a full report of each. In the same number appears the Editor's personal experience with raying maternity, chicks, eggs, and the use of high frequency currents upon the skin. Also, are the personal experiences of Dr. W. J. Morton, Carl Beck and Nikola Tesla in the same Journal.

In the November, 1898, issue, Vol. III, No. 5, of the AMERICAN X-RAY JOURNAL, are the original articles upon this same subject, by Professor Elihu Thomson, and one by Dr. Charles Lester Leonard. Following this, in the January, 1899, issue, Vol. IV, No 1, are the last and complete observations by Professor Elihu Thomson upon this all important subject.

The AMERICAN X-RAY JOURNAL gives correct data of all x-ray matter.

H. R.

Dr. I. Webster Fox of Philadelphia, Pa., has freely illustrated an interesting and valuable article in the *Philadelphia Medical Journal* entitled: "A New Localizer for Determining the Position of Foreign Bodies in the Eye by the Roentgen Rays.

How Some of the Mistakes are Made in Radiography.

By J. N. Scott, M. D.

(Read before the Roentgen Society of America, University Building, Buffalo, New York, Nov. 10, 1901.)

One of the principle reasons mistakes are made in interpetating radiographs is because a record is not made with each exposure of the position of the tube in relation to the part radiographed and to the plate; also the distance of the tube from the plate and the part exposed. All radiographs are distorted and unless we have the above data we cannot figure out the amount of distortion, so, of course, cannot interpetate the radiograph correctly.

The x-rays are like figures in that they are always correct. We may make a mistake in adding up a column of figures or other calculation. In the same way mistakes are often made in calculating our results in radiography, but that does not make the radiograph inaccurate.

The number of mistakes reported are becoming less and less, owing to the increased experience with the ray and improved technique.

A radiograph is a shadow picture and depends for its shadows between light and dark on the density to the ray of the substances interposed between the tube and plate.

As the ray emanates from a plate about ½ to 1 inch square, and the outlines obtained in a radiograph are shadows, all these shadows will be magnified in proportion to their distance and that of the source of ray from the plate. If we place the source of ray a considerable distance from the plate, for example, say 18 inches, and the object close, or about ¼ to ½ inch, the shadow picture will not be magnified much, but if the object is placed 8 inches from the plate and the source of ray 18 inches, the shadow picture will be magnified considerably, and we can figure out the exact amount. This fact can be illustrated very nicely by holding a piece of paper with a hole in it 1 inch in diameter in front of an electric or lamp light and throwing a shadow of the hand on the wall. First hold the hand close to the wall and the lamp 18 inches away; note how sharp the shadow of the hand is, and that it is magnified a very little, but as the hand is taken further from the wall it is magnified more, and the shadow is not so sharp and distinct.

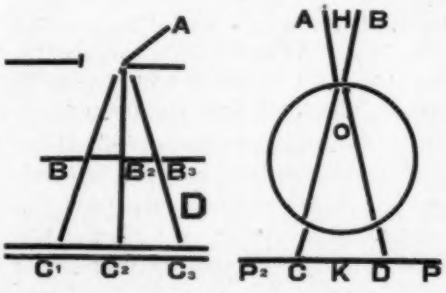
The x-ray effects a photographic plate in the same manner as ordinary light. If we wrap a photographic plate in black paper to protect it from light and expose it to the x-ray, it will be dark all over on development, showing it to have been effected by the ray, but if we interpose a hand with a fractured bone and a shot buried in another bone and repeat the process, the result will be a shadow picture, showing the outline of the flesh of the hand, the bones, the fracture and the shot. The x-ray light would penetrate the flesh, bones and the shot, but to a different degree. More ray would penetrate the flesh than the bones and shot and in the finished picture would appear lightest, because the emulsion was effected most where only the flesh was interposed. Bone being more dense to the ray than flesh, would obstruct more of it and the emulsion would be effected less where the bone and flesh were interposed than where only the flesh obstructed, consequently in the finished print the outline of the bones would appear darker

than the flesh. At the point of fracture the flesh only would be interposed and an outline of the fracture could be seen.

As the shot is more dense to the ray than bone, an outline of it would appear in the finished print. In order to obtain these shadows, there must be substances of different densities to the ray. An inflammatory exudate thrown out in dense muscular tissue would not show in a radiograph because it would be of the same density as the surrounding tissues, but a consolidation in the lung will show because the lung is very transparent to the ray and there would be a contrast between the density of the consolidation and the surrounding tissue. In interpetating all radiographs the thickness and transparency to the ray of all the parts must be considered; we must know the relative transparency of all parts of the body, and if searching for a foreign body its density in comparison with the surrounding tissues.

A grain of coffee or corn in the trachia of a child will not show because it is not as dense to the ray as the adjacent tissues, and we can locate no foreign body unless it is more dense to the ray than the surrounding tissues. As a general rule the ray penetrates substances in proportion to their density, but not always, and we must learn the exceptions. Cartilage is no more dense to the ray than muscular tissue, ligaments are a little more dense than muscle, fat is not as dense as muscle, dead bone, such as a sequestrum, is more dense than living bone; clotted blood is nearly as dense as bone, iodoform is much more dense than muscle, and if a bullet wound is dressed with it, it should be thoroughly cleansed out before an exposure is made to locate a foreign body. Glass is more dense than muscle, and can be located when in it.

In making a radiograph for locating any kind of foreign body, such as a bullet, needle, glass, etc., the following method can be used, or one which will accomplish the same result: The limb or body should be placed in a relaxed position and should be so marked that it can again be placed in exactly the same position. Two exposures should be made, as one exposure will give an imaginary line through the part on which the body is located, but will not tell us the depth in from either side. If the foreign body is in a limb, the two pictures can be taken at right angles to each other. Unless the foreign body is directly under the anode of the tube, it will not be above the point that it appears to be in the radiograph. The foreign body is always on a line from the point it appears to be in the radiograph to the anode of the tube. The reason of this is that the foreign body casts its shadow on the radiographic plate, and as the ray proceeds in a straight line from the anode, it must be on a line from its shadow on the plate to the anode. This fact has caused many unsuccessful operations for foreign bodies. The position of the foreign body in relation to its shadow can be shown by the diagram No. 1.



D represents the section of a limb; A the anode of the tube which is the center of radiation; B1, B2, B3, bullets; and C1, C2, C3, the shadow of the bullets

on the x-ray plate. B2 is directly over its shadow. B1 and B3 are not over their shadows, but on a line from C1 and C3 to the anode. In order to obtain the distance from C1, C2, C3, to B1, B2, and B3, an exposure can be taken at right angles to the first, and the same rules must be followed as at first. If the bullet was in the body the following methods could be used to locate it, both exposures being taken from before back.

Letting A represent the position of the anode in one exposure, it would throw a shadow of O representing the foreign body, on the plate P1 at D, and in the other exposure, B represents the anode which would cast the shadow of O at C on a second plate, P2. H K represents the distance of the anode of the tube from the plate. In order to locate the distance of the bullet from the plate, the following formula is used: O K equals C D, multiplied by H K and divided by A B, plus C D. In order to avoid mistakes in applying this formula, the following precautions must be used: The two plates used in the two exposures should be of the same size, and must be in exactly the same place on the body, or a cross of wire must be put on the body during the exposure, which will be a landmark to measure from. If the wire is placed next to the skin during the exposure, its imprint on the skin can be marked with nitrate of silver, which mark will generally last until the operation. In place of the above a wire screen of inch mesh can be bandaged on the body and its impression also marked with nitrate of silver. The shadow of the wire cross or wire screen will appear on the negative. The bones or a joint should never be used as a landmark to measure from for a foreign body, because being some distance from the plate, their position and that of the foreign body are distorted and the measurement will be inaccurate. The wire is so close to the plate that its position is not distorted. I only know of one way in which an error could be made when using the wire, but by cautioning the patient it could be prevented. It is by the patient moving a little, but not sufficient to move the skin at the place it was pressing on the wire. This would only occur where the skin was loose.

The distance of the anode of the tube from a marked point on the body directly under the anode should be recorded in exposure by all methods as the imaginary line from the position of the anode of the tube to the shadow of the foreign body can only be obtained by measuring from it. A handy method of accurately obtaining the point directly under the anode is to use a small plumb line made by attaching a weight to a string about 14 inches long, passing the free end through a cork from end to end; pass another string about 8 inches long through the cork from side to side; attach to each end of the string a ring about two inches in diameter with sufficient of the side cut out to allow it to slip over the glass terminal of each end of tube; the cork can be adjusted so it is directly under anode of the tube, by sliding it on the string connecting the two rings. The length of the plumb line can also be adjusted by pulling its string through the cork.

As the bones are distorted we can not place the finished picture on the same place the negative was during the exposure; if we depend on them for landmarks, so to be accurate, the finished picture must be placed over the corresponding marks made on the body and picture made by the cross wires or screen. Radiographs of bullets, needles, etc., especially if they have just been re-

ceived, should be made immediately before operation, and the parts kept as immobile as possible from time of making exposure until operation; otherwise they are liable to move.

When making a radiograph to locate a needle, have all surrounding muscles relaxed, because the part may apparently not move, but the muscles may move slowly and thus move the needle so a shadow will not be obtained, although the outline of the bones will be sharp. Several times I have failed to obtain a picture showing the needle on the first exposure on this account. After making an exposure to locate a needle, the part should be bandaged so the muscles will move no more than is necessary.

All fractures should be taken from two directions and sometimes three. If taken from two directions, they should be taken at right angles to each other. An oblique fracture may be separated some distance and unless the detail in the radiograph is splendid, it will appear as if the bones were in apposition, and in a straight line, but taken at right angles to the first it will show it to be an oblique fracture and the amount of separation. It is an easy matter to obtain an outline of the bones in the extremities, but in fracture, especially into the joints, it is necessary to have a radiograph with sharp outlines and plenty of detail so that one small fragment overlapping another can be distinctly seen. The position of the tube in relation to the part radiographed should always be recorded; also its distance from the part and from the plate, and the position of the plate on the part should be marked with the cross wire, which will leave an impression on the plate, and its position can be marked on the body. If possible the fracture should be located with the fluoroscope, and the point of the break placed over the center of the plate and under the anode of the tube. In the above manner there will be as small an amount of distortion as can be obtained. When making radiographs for physicians who are not familiar with the laws of the X-ray, they should always be informed that the finished radiograph is reversed when placed in the same position that the plate was in making the exposure; that is, that the right side will appear as the left and the left as the right, and it is well to mark on the radiograph which is the right side and which is the left.

KANSAS CITY, MO.

Injurious Forces From X-Ray Tubes.

Dr. Robert Kienboeck of Vienna, Austria, in the January number of the *Inter-State Medical Journal*, has an article on the Technique of X-Ray Therapy. This is a timely article and has many good points in it. But there is one observation that requires hasty correction. He writes: "The active agency of the functionating Roentgen tube is the x-ray and no other forces which come off from the Roentgen tube, (*e. g.*, kathodal rays do not penetrate the wall of the tube, at the same time electrical waves of known vibration have no effect upon the skin.) Further, the exposure of the skin to the action of static electricity and electrical sparks is, as far as these peculiar changes are concerned, without any significance." Again he writes: "The rays from the glass walls of the tube and from

the positive pole of the anti-kathode can, for all practical purposes, be disregarded on account of their slight intensity."

Now in regard to this last quotation; if it is true that the rays that are absorbed by the tissues are the curative ones, and those which go on to infinity are inert, then it is certain that the rays last mentioned have curative properties for they do penetrate the skin. But it is the first statement that is not only erroneous, but is calculated to render injury.

THE AMERICAN X-RAY JOURNAL, August, 1897, showed plainly how such currents can and do injure the skin. Since then the more powerful static machines have been made, and from tubes thereto attached, "other forces" than the x-rays have injured the skin. Many persons were injured from these sparks, which should be regarded "without any significance," while using the high frequency apparatus.

If the theory advanced were true, then the closer the tube is to the patient, the greater the immunity from danger. The truth is that every person who has attempted to manipulate the tube with the hand, an effectual practice for improving the radiance, has lost his finger nails. Every person who makes a practice of holding with his fingers a plate, at the time he makes the exposures, finds the flesh of his fingers crusting and cracking. Every person who has made a practice of using his hands about a tube in action, or about a tube he is trying to regenerate has developed a dermatitis. Static electricity and electric sparks should concern us when such force comes from a Roentgen tube, for they are destructive to the skin.

H. R.

Pus Foci in Bone is the title of a paper that was permitted to be read before the Brooklyn Pathological Society in April, last year. The paper was short and consisted simply of reports of cases. There was no discussion. Dr. J. Sherman Wight, the author of the paper, showed radiographs illustrating the

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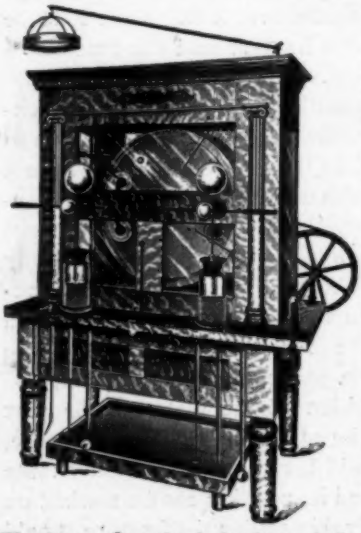

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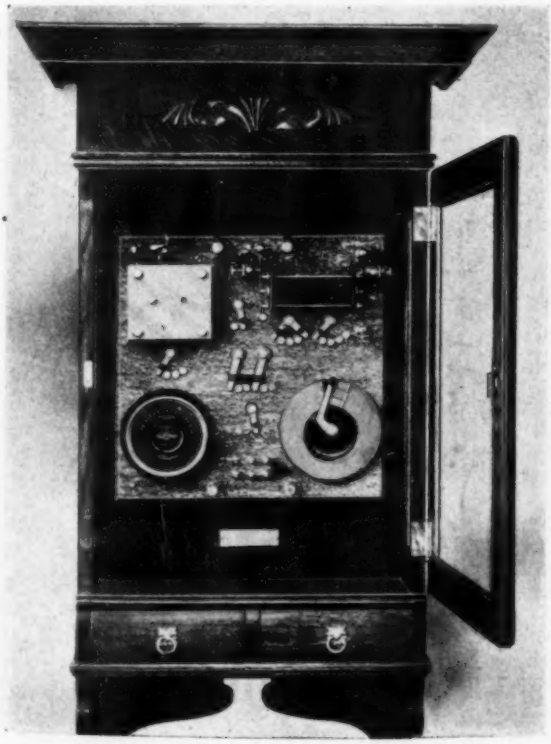
cases in the report. There are two points of interest in this report—First: the pictures show that the operator was master of his work. Dr. Wight is a surgeon. The x-rays brought to light what no other method of diagnosis could have done, and he operated from the facts thereby acquired, with the best results obtainable. One case of ankylosis of the elbow is especially interesting. It was an old tuberculous joint in which the external condyle was a mass of dead bone and pus surrounded with a thin shell of bone. The x-ray picture gave all the detailed information, and the surgeon performed a linear osteotomy. Repair was complete with motion through an arc of 65 degrees. Most of the cases mentioned in the paper involved the joints. The second point of interest is, that after all, the paper was not read—only by title. We are not aware of just the reason, but we feel quite certain that if Dr. Wight should present another paper on some surgical procedure, in which the x-rays figured in the case, he would be asked to read it. The past twelve months has added immensely to the surgical interest of the x-rays. Societies that ignore the tenets of our profession must lose the respect of modern practitioners.

H. R.



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X-Ray Divergence Chart.

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By S. H. MONELL, M. D.

This chart shows at a glance the following points of essential interest to the X-Ray operator:—

1. A Plane Diagram of X-light radiations from the *anode* focus-point.

2. The rate of departure of X-Rays from a parallel path at different distances from the tube.

3. The proportionate loss of right-angle shadows at different distances horizontal to the perpendicular axis.

4. The area of non-distorted field of observation at any distance from the tube.

5. The area within which a body of any thickness will shadow a right-angled relation of the parts at a given distance from the tube.

6. The distance from the tube at which a part and the photographic plate must be exposed to secure essential correctness and non-distortion for a diagnostic field of any given size.

7. The general area of approximate non-distortion on the plate.

8. The obliquity of shadows at all distances outside of the central field of exact perpendicularity of radiation.

The Scale of the Chart reads down from the focus-point of the tube to an imaginary plate twenty inches distant. For greater distances, extend the indicated lines below the Chart, and apply the same rule of interpretation. For full explanatory description see Chapter XVIII.

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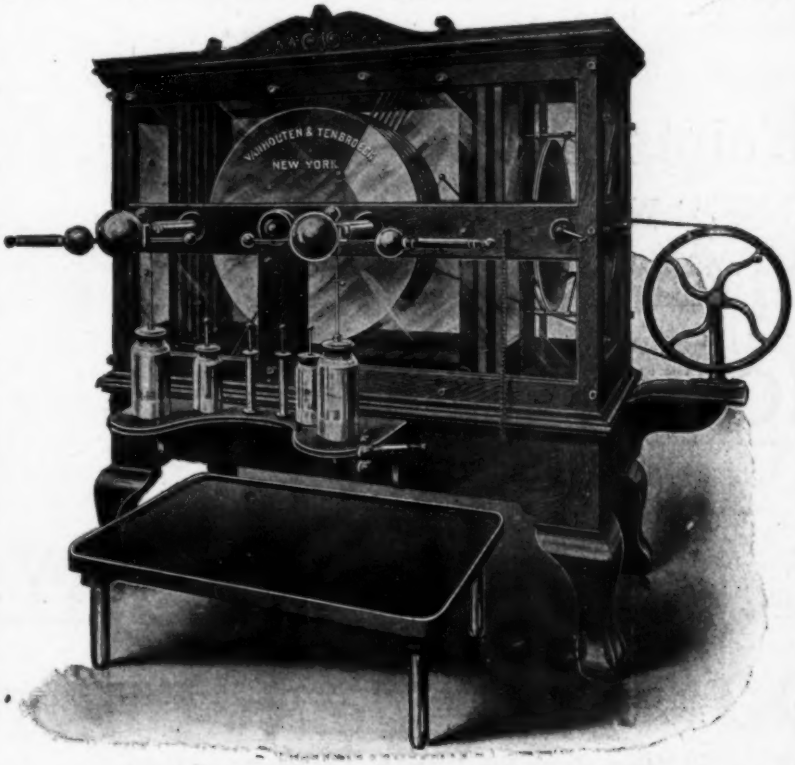

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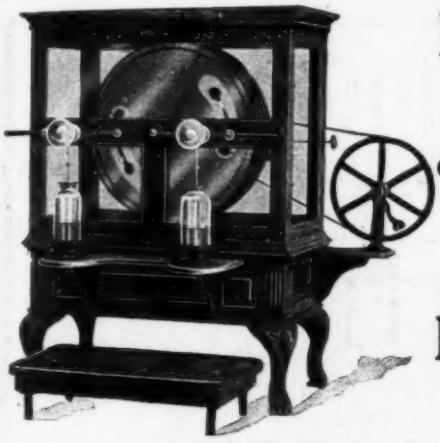

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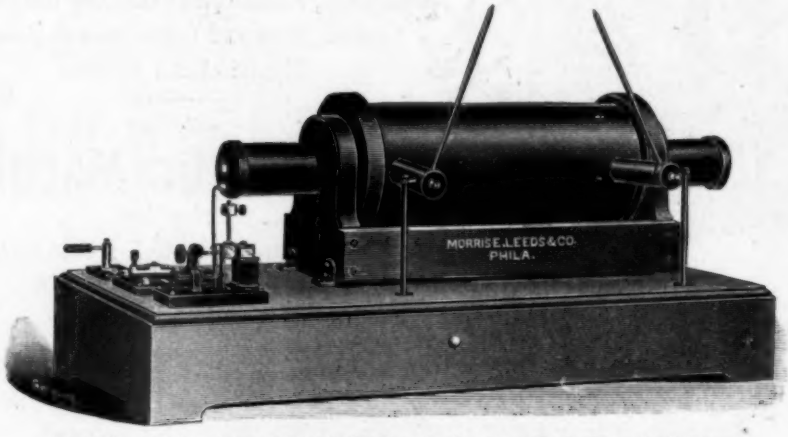

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